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A WHEEL BEARING AND A BEARING APPARATUS FOR A WHEEL OF VEHICLE OF SEMI-FLOATING TYPE HAVING THE WHEEL BEARING

BACKGROUND OF THE INVENTION

[0001]

Field of the Invention

The present invention relates to a bearing apparatus for a wheel of vehicle for rotatably supporting the wheel relative to a suspension apparatus of vehicle, and more particularly to a wheel bearing in which a driving wheel is supported by a double row rolling bearing and a bearing apparatus for a wheel of vehicle of semi-floating type having the wheel bearing.

[0002]

Description of Background Art

In a vehicle such as a truck having a body of frame structure, an axle structure of driving wheel of full-floating type has been widely adopted. In a recent driving wheel supporting structure, there has been widely adopted a unit structure of a double row rolling bearing so as to improve the readiness of assembly, reduction of weight and size. One example of such a bearing apparatus for a wheel of vehicle of the prior art is shown in Fig. 4.

[0003]

In this bearing apparatus for a wheel of vehicle, a driving shaft 52 connected to a differential apparatus (not shown) is inserted into an axle housing 51 and a double row conical roller bearing 53 is mounted on the axle housing 51. A hub wheel 54 rotatably supported by the double row conical roller bearing 53 is connected to a flange 56 via hub bolts 55. A pair of inner ring 57 are connected each other by a connecting ring 58 and fitted onto the end of the axle housing 51 and then securely fastened by a fastening nut 59.

On the other hand an outer ring 60 of the double row conical roller bearing is fitted into the hub wheel 54 and axially secured with its both ends being sandwiched by the flange 56 of the driving shaft 52 and a brake rotor 61. A double row conical rollers 62 are rollably contained by cages 63 between the annular space between the inner and outer rings 57 and 60 and seals 64 are arranged at both ends of the annular space to seal the inside of the wheel bearing off from the outside.

【0004】

The inboard side end of the inner ring 57 is formed with an annular stepped portion 65 on which a seal ring 66 is mounted. An annular recess 67 is formed on the outer circumferential surfaces at mutually abutted portions of the pair of inner rings 57 and a seal ring 68 of elastic member is fitted therein. These seal rings 66 and 68 prevent penetration or ingress of rain water or dusts into the axle housing 51, leakage of differential gear oil to outside and ingress of the differential gear oil into the inside of the bearing (see Japanese Laid-open Patent publication No. 99172/2001).

Disclosure of the Invention

Problems to be solved by the Invention

【0005】

However since the bearing apparatus for a wheel of vehicle of the prior art has a structure such that the double row of conical roller bearing 53 is arranged between the hub wheel 54 and the axle housing 51 and that the driving shaft 52 is inserted into the axle housing 51 and then the flange 56 of this driving shaft 52 is connected to the hub wheel 54 by the hub bolts 55, reduction of the weight and size of the bearing apparatus is limited as well as assembly of the bearing apparatus is complicated by requirement of a large number of structural parts.

SUMMARY OF THE INVENTION

[0006]

It is therefore an object of the present invention to provide a bearing apparatus for a wheel of vehicle which can reduce the weight, size and a number of parts and also can prevent ingress of rain water or dusts and leakage of differential gear oil.

[0007]

For achieving the object, there is provided, according to the present invention of claim 1, a bearing apparatus for a wheel of vehicle structured as a unit of a hub wheel and a double row rolling bearing comprising an inner member including a hub wheel integrally formed on its one end with a wheel mounting flange and on its inner circumferential surface with a serration and having an axially extending cylindrical portion and inner rings press-fitted onto the cylindrical portion of the hub wheel and formed on which outer circumferential surface with at least one of inner raceway surfaces; an outer member arranged around the inner member and formed with double row outer raceway surfaces on its inner circumferential surface oppositely to the inner raceway surfaces; double row rolling elements arranged between the inner and outer raceway surfaces of the inner member and the outer member; a cage for freely rollably holding the rolling elements; and seals for sealing an annular space between the inner member and the outer member characterized in that a partition wall is integrally formed on the hub wheel at its outboard side for closing a central bore of the hub wheel.

[0008]

According to the present invention of claim 1, since the partition wall is integrally formed on the hub wheel at its outboard side for closing a central bore of the hub wheel, the rigidity of the hub wheel is increased and thus it is possible to suppress the elastic deformation of the hub wheel and to improve the durability of the bearing apparatus.

[0009]

According to the present invention of claim 2, since said at least one of inner raceway surfaces is formed directly on the outer circumferential surface of the hub wheel, it is possible to further reduce the weight and size and increase the rigidity of the bearing.

【0010】

According to the present invention of claim 3, since the end of said cylindrical portion is plastically deformed radially outward to form a caulked portion for preventing the inner ring from being slipped off from the cylindrical portion of the hub wheel, it is unnecessary to control the amount of preload of the bearing as in the prior art by tightly fastening the inner ring using a nut. Thus easiness of assembly of the bearing apparatus to a vehicle can be improved and the predetermined amount of preload can be kept for a long term. In addition it is possible to substantially reduce the number of parts and to reduce the manufacturing cost and the weight and size of the bearing due to the improvement of the easiness of assemble.

【0011】

Preferably according to the present invention of claim 4, since the outer circumferential region of the wheel mounting flange from its base of inboard side to the cylindrical portion is hardened by high frequency induction hardening as having the surface hardness 58～64 HRC, and the caulked portion is remained unhardened as having the surface hardness of 25 HRC or less after forging, it is possible to improve the durability of the hub wheel and workability of the caulked portion during its plastic deformation and thus the reliability of quality of the bearing.

【0012】

According to the present invention of claim 5, since a bearing apparatus for a wheel of vehicle of a semi-floating type comprising an axle housing supported under a body of vehicle; a hollow driving shaft inserted into the axle housing; and the bearing apparatus for a wheel of vehicle of any one of

claims 1～4 arranged between the driving shaft and an opening of the axle housing; and the driving shaft is connected to said inner member so that a torque is transmittable therebetween, it is possible to provide a bearing apparatus for a wheel of vehicle of semi-floating type which has a high rigidity and can reduce the weight and size and also can prevent the leakage of differential gear oil to the outside as well as the ingress of rain water or dusts from the outside into the differential gear oil through the driving shaft.

【0013】

According to the present invention of claim 6, since the driving shaft is separably connected to the inner member via the serration, the workability of assembly of the bearing apparatus can be remarkably improved.

Effect of the Invention

【0014】

According to the bearing apparatus for a wheel of vehicle of the present invention, since the bearing apparatus for a wheel of vehicle is structured as a unit of a hub wheel and a double row rolling bearing comprises an inner member including a hub wheel integrally formed on its one end with a wheel mounting flange and on its inner circumferential surface with a serration and having an axially extending cylindrical portion and inner rings press-fitted onto the cylindrical portion of the hub wheel and formed on which outer circumferential surface with at least one of inner raceway surfaces; an outer member arranged around the inner member and formed with double row outer raceway surfaces on its inner circumferential surface oppositely to the inner raceway surfaces; double row rolling elements arranged between the inner and outer raceway surfaces of the inner member and the outer member; a cage for freely rollably holding the rolling elements (5); and seals for sealing an annular space between the inner member and the outer member; and is characterized in that a partition wall is integrally formed on the hub wheel at its outboard side for closing a central bore of the hub wheel, the rigidity of the

hub wheel is increased and thus it is possible to suppress the elastic deformation of the hub wheel and to improve the durability of the bearing apparatus.

【0015】

In addition, according to the bearing apparatus for a wheel of vehicle of the present invention, since a bearing apparatus for a wheel of vehicle of a semi-floating type comprising an axle housing supported under a body of vehicle; a hollow driving shaft inserted into the axle housing; and the bearing apparatus for a wheel of vehicle of any one of claims 1～4 arranged between the driving shaft and an opening of the axle housing; and the driving shaft is connected to said inner member so that a torque is transmittable therebetween, it is possible to provide a bearing apparatus for a wheel of vehicle of semi-floating type which has a high rigidity and can reduce the weight and size and also can prevent the leakage of differential gear oil to the outside as well as the ingress of rain water or dusts from the outside into the differential gear oil through the driving shaft.

Best mode for carrying out the Invention

【0016】

According to the present invention, there is provided a bearing apparatus for a wheel of vehicle structured as a unit of a hub wheel and a double row rolling bearing comprising an inner member including a hub wheel integrally formed on its one end with a wheel mounting flange and on its inner circumferential surface with a serration and having an axially extending cylindrical portion and inner rings press-fitted onto the cylindrical portion of the hub wheel and formed on which outer circumferential surface with at least one of inner raceway surfaces; an outer member arranged around the inner member and formed with double row outer raceway surfaces on its inner circumferential surface oppositely to the inner raceway surfaces; double row rolling elements arranged between the inner and outer

raceway surfaces of the inner member and the outer member; a cage for freely rollably holding the rolling elements; and seals for sealing an annular space between the inner member and the outer member; characterized in that a partition wall is integrally formed on the hub wheel at its outboard side for closing a central bore of the hub wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

Additional advantages and features of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a longitudinal-section view of a first embodiment of a bearing apparatus for a wheel of vehicle of the present invention;

Fig. 2 is a partially enlarged longitudinal-section view of Fig. 1 showing a wheel bearing;

Fig. 3 is a longitudinal-section view of a second embodiment of a bearing apparatus for a wheel of vehicle of the present invention; and

Fig. 4 is a longitudinal-section view of a bearing apparatus for a wheel of vehicle of the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described with reference to accompanied drawings.

First embodiment

【0017】

Fig. 1 is a longitudinal-section view of a first embodiment of a bearing apparatus for a wheel of the present invention, and Fig. 2 is a partially enlarged longitudinal-section view of Fig. 1. In the description of the present invention, a side of a bearing positioned outward a vehicle when it is mounted on a vehicle is referred to as "outboard" side (the left side in a drawing), and a

side inward a vehicle is referred to as "inboard" side (the right side in a drawing).

[0018]

In a bearing apparatus for a wheel of vehicle of the present invention, a hub wheel 1 and a double row rolling bearing 2 are formed as a unit and connected to a driving shaft "D/S". The double row rolling bearing 2 comprises an inner member 3, an outer member 4, and a double row rolling elements (tapered rollers) 5 freely rollably contained between the inner and outer members 3 and 4. The inner member 3 includes the hub wheel 1 and a pair of inner rings 10 press-fitted onto the hub wheel 1. The hub wheel 1 is integrally formed, at its outboard side, with a wheel mounting flange 6 on which, a wheel "W" and a brake rotor "B" are mounted and from which an axially extending cylindrical portion 7 extends. An inner circumferential surface (bore) of the hub wheel 1 is integrally formed with a serration (or spline) 8 into which a serrated portion of the driving shaft "D/S" is inserted so that a torque can be transmitted therebetween and with a partition wall 9 on the outboard side of the hub wheel 1 for closing a central bore (inner circumferential surface) of the hub wheel 1.

[0019]

As shown in Fig. 2, the double row rolling bearing 2 comprises an outer member 4 formed with double row outer raceway surfaces 4a on its inner circumferential surface and with a body mounting flange 4b to be secured on an axle housing "H" on its outer circumferential surface, a pair of inner rings 10 inserted in the outer member 4 and formed with double row tapered inner raceway surfaces 10a on its outer circumferential surface oppositely to the outer raceway surfaces 4a, double row rolling elements 5 arranged between the inner and outer raceway surfaces 10a, 4a, and a cage 11 for freely rollably holding the rolling elements 5. Each of the inner rings 10 is formed with, at its larger diameter end, a large flange 10b for guiding the rolling elements 5.

The pair of inner rings 10 are arranged so that their inner ends are abutted each other and thus form so-called a back-abutted type double row tapered roller bearing. Seals 12are arranged at either ends of the outer member 4 seal an annular space between the outer member 4 and the inner rings 10. These seals 12 prevent both penetration of rain water or dusts from the external circumstances and leakage of lubricating grease sealed within the bearing. The inboard side seal 12 further prevents penetration or ingress of differential gear oil into the inside of the bearing passing through the serration 8 of the hub wheel 1.

【0020】

The pair of inner rings 10 are press-fitted onto the cylindrical portion 7 of the hub wheel 1 and are prevented from being axially slipped off from the cylindrical portion 7 by a caulked portion 13 formed by plastically deforming the end of the cylindrical portion 7 radially outward. Since this embodiment adopts the self-retaining structure of the second generation, it is not required to control an amount of preload as a conventional manner by tightly fastening a nut against the inner ring. Accordingly, it is possible to substantially reduce the number of parts and thus to improve the readiness of assembly as well as to reduce its manufacturing cost, weight and size.

【0021】

The hub wheel 1 is made of medium carbon steel such as S53C including carbon of 0.40～0.80%by weight and hardened by high frequency induction quenching so that the base of the wheel mounting flange 6 at its inboard side and the cylindrical portion 7 of the hub wheel 1 have the surface hardness of 58～64 HRC (the hardened portion is shown in drawings by cross-hatched lines). The caulked portion 13 is remained as a unhardened portion having its surface hardness of 25 HRC or less. This improves the durability and workability of the caulked portion 13 and also prevents generation of cracks therein.

【0022】

The outer member 4 is also made of medium carbon steel such as S53C including carbon of 0.40～0.80%by weight and the double row outer raceway surfaces 4a and inner circumferential surface of the outer member 4 on which the seal 12is mounted are hardened by high frequency induction quenching so that their surface hardness is within 58～64 HRC. On the other hand, the inner rings 10 is made of high carbon chrome bearing steel such as SUJ2 and hardened to its core by dipping quenching to have the surface hardness of HRC 58～64. Although it is herein illustrated a double row tapered roller bearing using tapered roller as rolling elements 5, the double row angular ball bearing using balls may be also used.

【0023】

In this embodiment, since the partition wall 9 is integrally formed on the hub wheel 1 at its outboard side for closing the central bore (inner circumferential surface) of the hub wheel 1, high rigidity of the hub wheel 1 can be maintained high although it is used in the bearing apparatus of the semi-floating type and thus it is possible to suppress an elastic deformation of the hub wheel 1 although when the moment load is applied to the hub wheel 1 during running of a vehicle and also to surely prevent ingress of rain water or dusts from the ambient circumstances into the driving shaft "D/S" and thus into the differential gear oil.

Second embodiment

【0024】

Fig. 3 is a longitudinal-section view of a second embodiment of a bearing apparatus for a wheel of vehicle of the present invention. Since difference of this embodiment from the first embodiment only resides in the structure of the hub wheel, same numerals are used as those used in the first embodiment for designating the same structural elements.

【0025】

This bearing apparatus for a wheel of vehicle is structured as a unit of the hub wheel 14 and a double row rolling bearing 15. The double row rolling bearing 15 comprises an inner member 16, an outer member 4, and a double row rolling elements 5 and 5 freely rollably contained between the inner and outer members 16 and 4. The inner member 16 includes the hub wheel 14 and the inner wheel 10 press-fitted onto the hub wheel 14. The hub wheel 14 is integrally formed, at its outboard side, with a wheel mounting flange 6 on which, a wheel (not shown in Fig. 3) is mounted and with an inner raceway surface 14a of the outboard side of the bearing 15and has the cylindrical portion 7 axially extending from the inner raceway surface 14a. The hub wheel 14 is formed on its inner circumferential surface (bore) with a serration (or spline) 8 into which a serrated portion of the driving shaft (not shown in Fig. 3) is inserted so that a torque can be transmitted therebetween and with a partition wall 9 on the outboard side of the hub wheel 14 for closing a central bore (inner circumferential surface) of the hub wheel 14.

【0026】

The outer circumferential surface of the hub wheel 14 is formed with a flange portion 14b corresponding to the large flange 10b of the inner ring 10, and a stepped portion 14c to which an inner end face (smaller end face) abuts. Thus the so-called back-abutted type double row tapered roller bearing is structured. In addition the inner ring 10 is press-fitted onto the cylindrical portion 7 of the hub wheel 14 and is prevented from being axially slipped off from the cylindrical portion 7 by a caulked portion 13 formed by plastically deforming the end of the cylindrical portion 7 radially outward. Since this embodiment adopts the self-retaining structure of such a third generation, it is not required to control an amount of preload as a manner similar to the first embodiment by tightly fastening a nut against the inner ring. Accordingly, it is possible to improve the readiness of assembly as well as to maintain the amount of preload for a long term.

【0027】

Since the inner raceway surface 14a is directly formed on the outer circumferential surface of the hub wheel 14 and the partition wall 9 is also integrally formed on the hub wheel 14 at its outboard side end, the rigidity of the hub wheel 14 is increased. Accordingly, it is possible to suppress an elastic deformation of the hub wheel 14 although when the moment load is applied to the hub wheel 14 during running of a vehicle and also to surely prevent ingress of rain water or dusts from the ambient circumstances into the driving shaft "D/S" and thus into the differential gear oil.

Applicability in industry

【0028】

The bearing apparatus for a wheel of vehicle of the present invention can be applied to a bearing apparatus for a wheel of vehicle of driving wheel side of the semi-floating type in which a wheel bearing is arranged in opened portions between a driving shaft and a axle housing.

【0029】

The present invention has been described with reference to the preferred embodiment. Obviously, modifications and alternations will occur to those of ordinary skill in the art upon reading and understanding the preceding detailed description. It is intended that the present invention be construed as including all such alternations and modifications insofar as they come within the scope of the appended claims or the equivalents thereof.